Washington State Air Toxics Assessment and Diesel Emissions Studies

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Diesel Technology

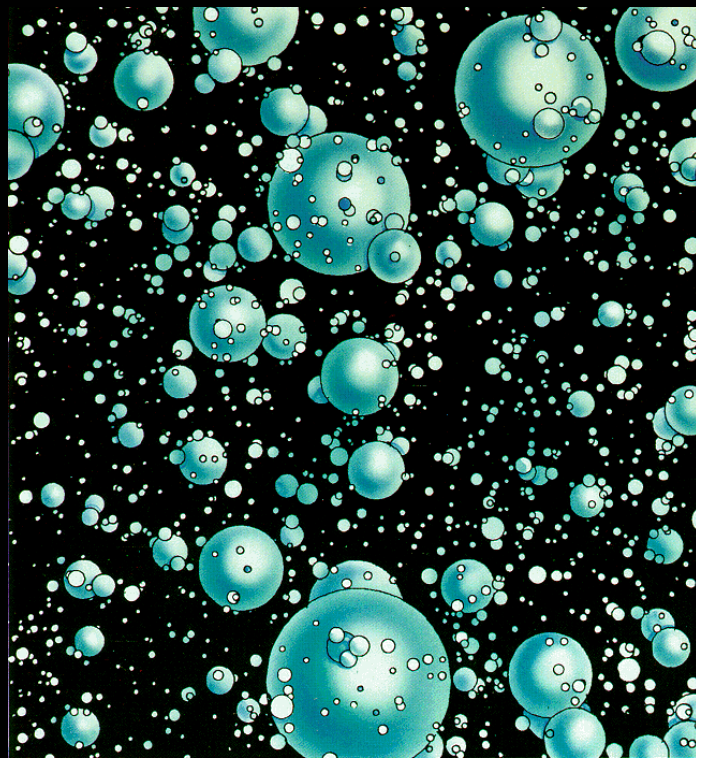
- **Powerful: high compression ratio, i.e., 16 to 25: 1; (gasoline engines 8 to 12:1)**
- **Durable: large truck can log 1,000,000 miles (with overhaul)**
- **Energy efficient: Fuel contains more energy 147,000 BTU/gallon (gas: 125,000 BTU/gallon)**
- **Heavy-duty diesel engines emit 30–100 times as many particles as do gasoline engines.**

Major Constituents of Diesel Emissions

Gas or Vapor

- CO_2
- CO
- NO, NOx
- SOx

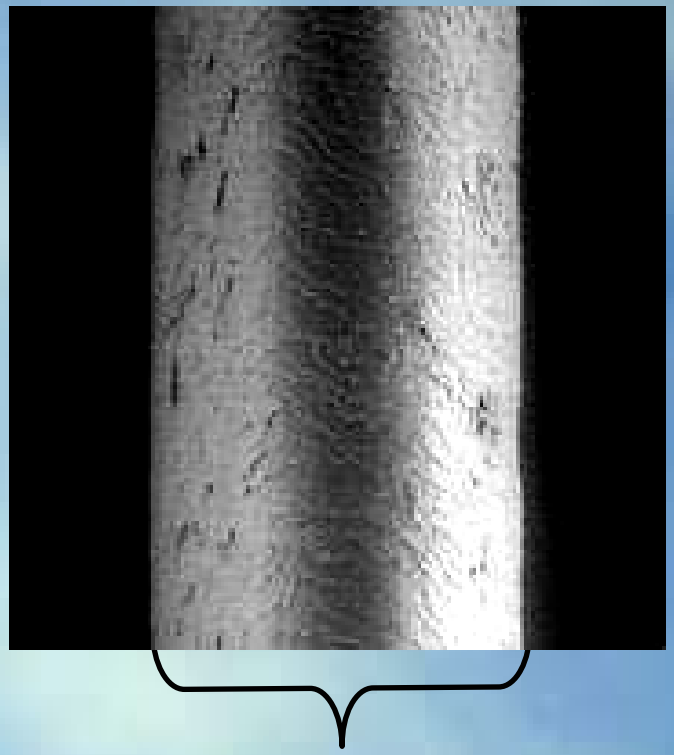
Hydrocarbons: benzene, 1,3-butadiene, acrolein, PAHs and nitroPAHs phenol, ethylene, methane, etc.



Particles: porous core of carbon (soot) with up to 18,000 combustion products adsorbed

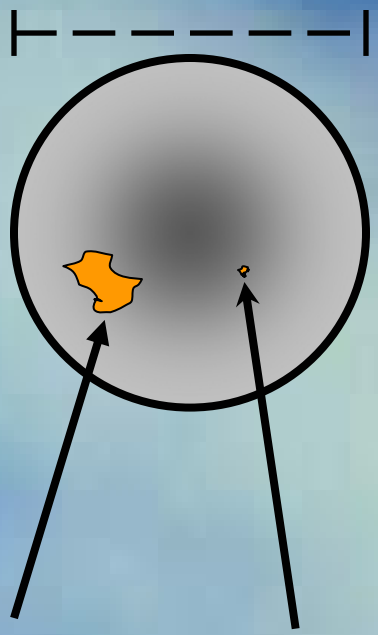
Smoke

A mixture of extremely small solids and liquid droplets



Human Hair (70 µm diameter)

Hair cross section (70 µm)

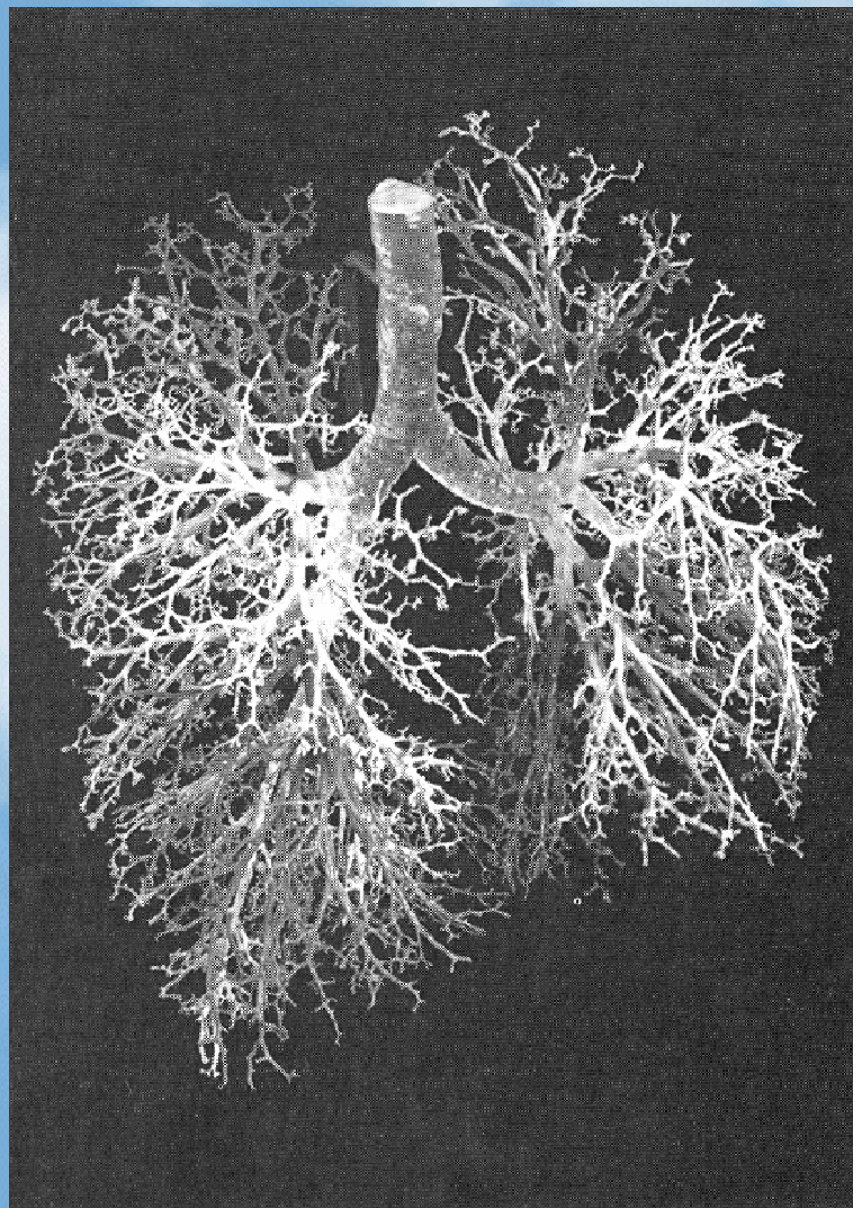


PM_{10} (10µm)

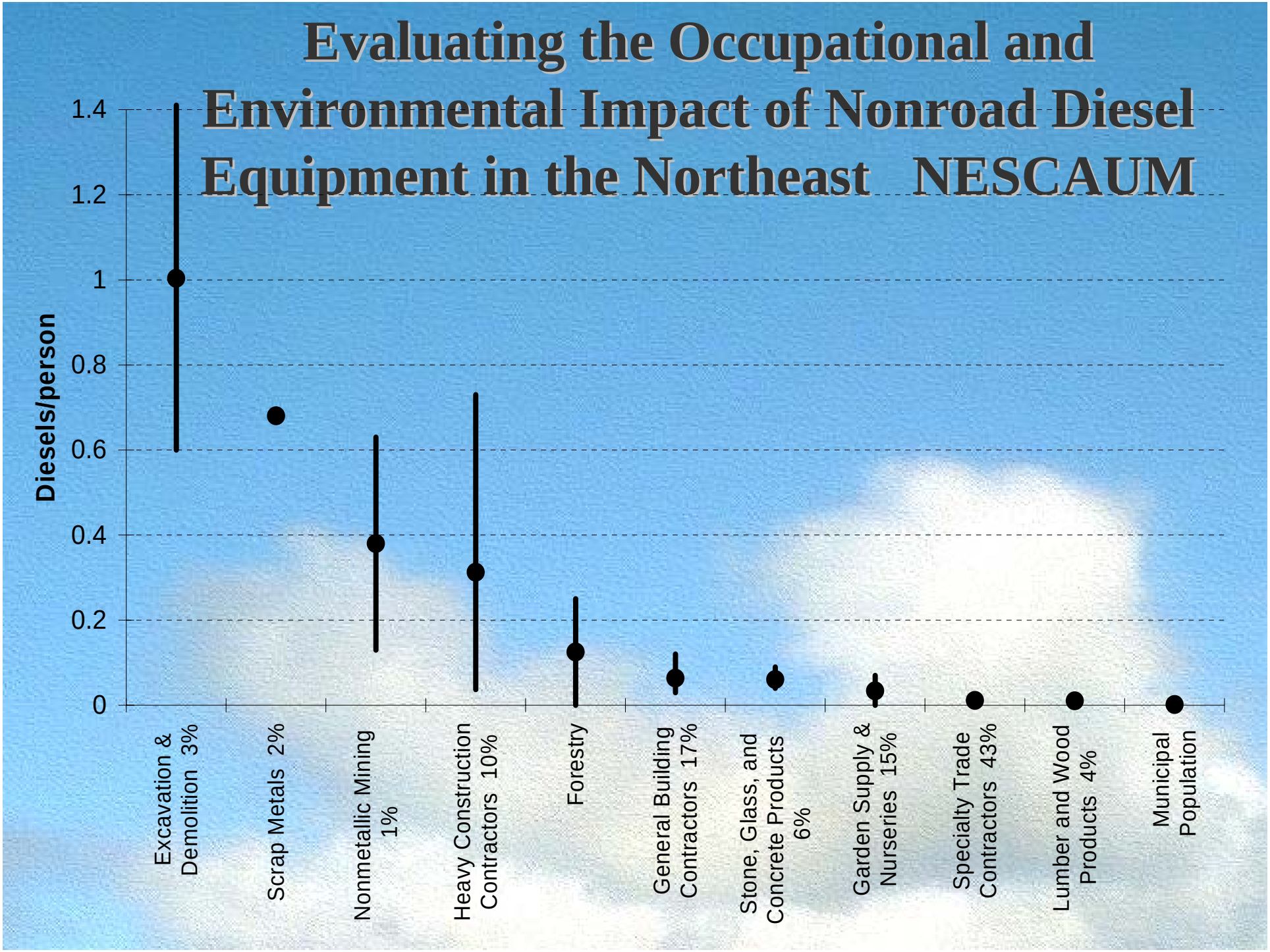
$PM_{2.5}$ (2.5 µm)

Diesel Exhaust Particles

- The smaller they are the further they can go into the lungs, and the greater the potential for damaging health
- 95% of DEPs are less than 1 μm
- The average size is 0.2 μm
- Exposure of construction workers, engine mechanics, truckers, etc. to DEP is an occupational health concern

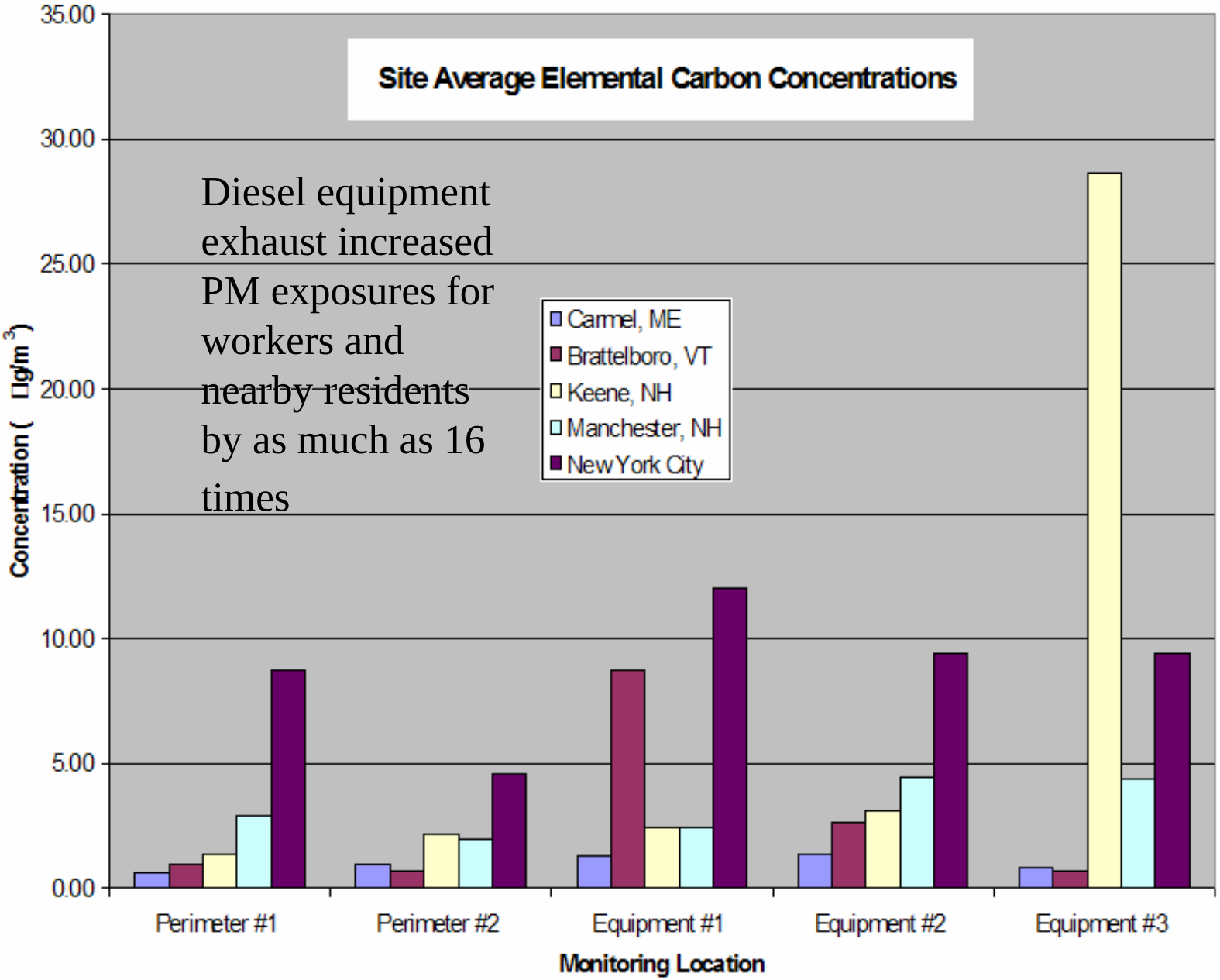


Evaluating the Occupational and Environmental Impact of Nonroad Diesel Equipment in the Northeast NESCAUM



NESCAUM

- DEP levels rose and fell with intervals of ~15-20 minutes
- Workers' 24-hour $PM_{2.5}$ exposures could exceed current air quality standards by nearly 2 to 3.5 times – substantially increasing health risk
- DEP was estimated to exist at levels that pose risk of chronic inflammation and lung damage
- Acetaldehyde, benzene, and formaldehyde were as much as 140 times the federally established screening threshold for cancer risk.


Site Average Elemental Carbon Concentrations
Diesel equipment exhaust increased PM exposures for workers and nearby residents by as much as 16 times
Carmel, ME
Brattelboro, VT
Keene, NH
Manchester, NH
New York City
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Concentration (Ug/m3)
Perimeter #1
Perimeter #2
Equipment #1
Equipment #2
Equipment #3
Monitoring Location

Bronchitis and Imflammation

- Tunnel workers appear to be at increased risk for chronic bronchitis. Symptomatic workers self-selected out of this trade

- Customs officers occupied with clearing of diesel trucks had chronic inflammation of the nasal mucous membranes

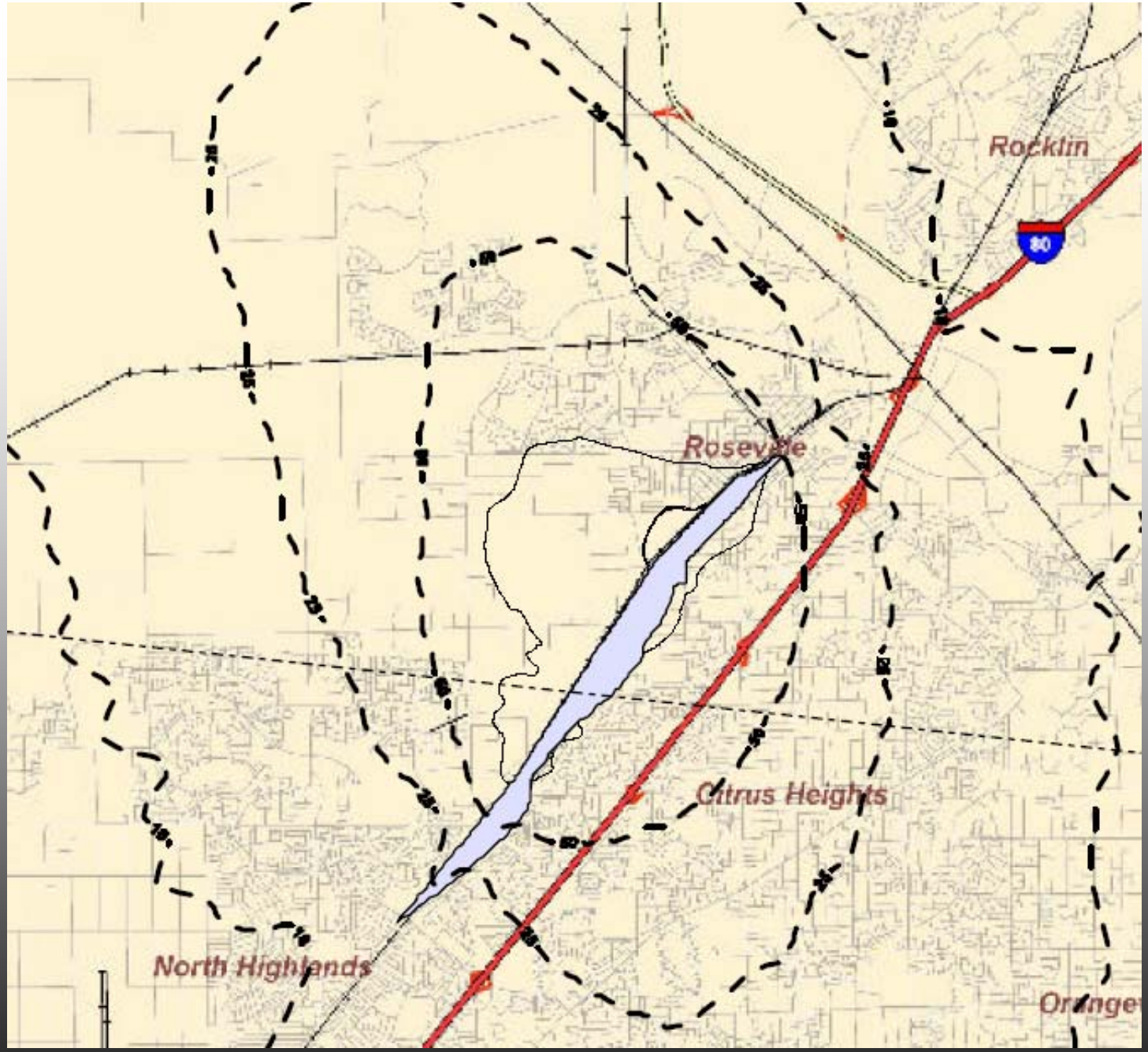
Asthma

- 20 occupational DE exposure studies reveal a mixed picture of adverse and no asthma effects
- The "healthy worker effect" likely influenced findings
- Stronger associations in susceptible individuals in the general population - including people with asthma, children and elderly - are likely

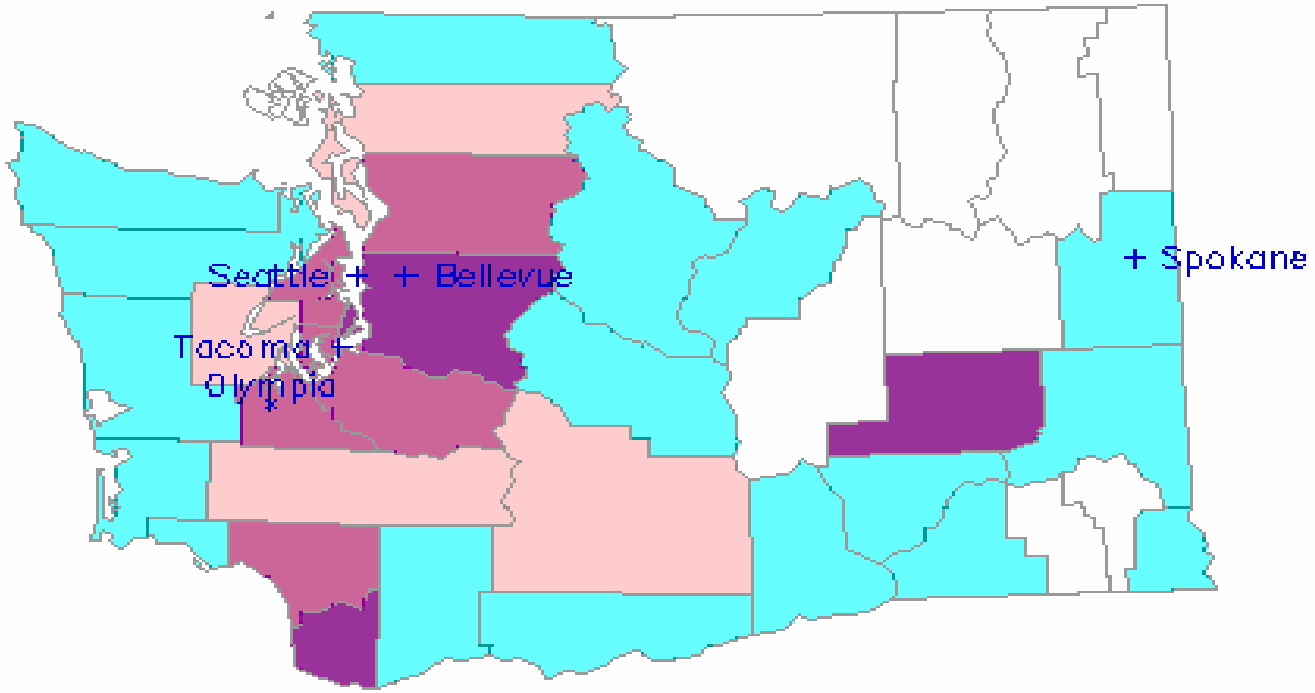
Cancer risk among heavy equipment operators

Jarvholm showed that subjects who always worked in a cabin had a lower lung cancer risk than subjects who worked in the open.

California Air Resources Board Roseville Rail Yard Study


Rocklin
80
Roseville
Citrus Heights
North Highlands

1996 Estimated County Median Exposure Concentration
Diesel Particulate Matter — WASHINGTON Counties

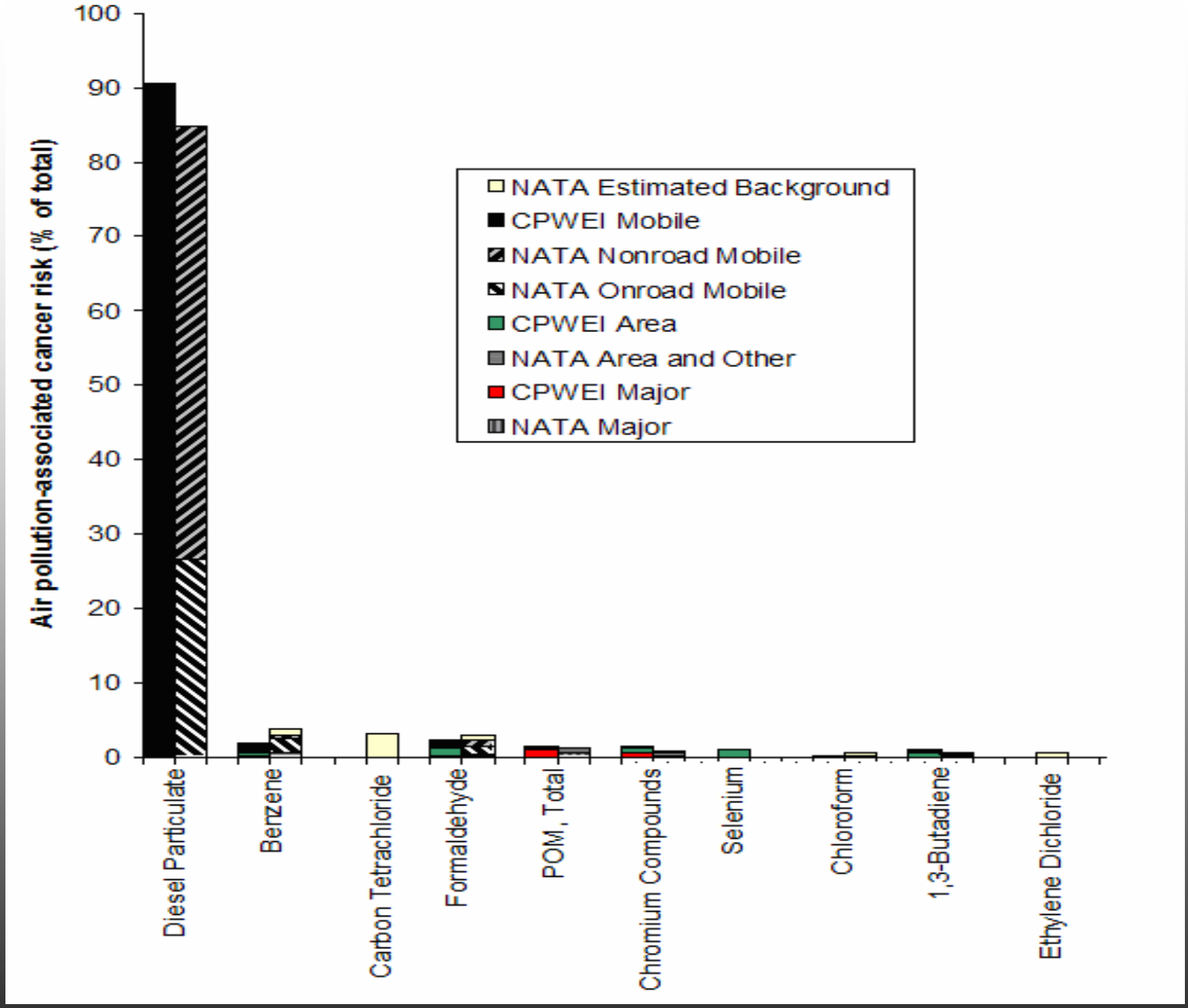


Distribution of U.S. Inhalation Exposure Concentration

Percentile	County Median Exposure Concentration (micrograms / cubic meter)	Lifetime chances per million of DPM-related cancer
Highest in U.S.	10.2	
95	1.35	405
90	1.04	312
75	0.6985	210
50	0.448	134
25	0.2685	81
Lowest in U.S.	0	0

Cancer unit risk Source: California OEHHA/ARB
Approved Risk Assessment Health Values

Source: U.S. EPA / OAQPS
NATA National–Scale Air Toxics Assessment


Air pollution-associated cancer risk (% of total)
100
90
80
70
60
50
40
30
20
10
0
NATA Estimated Background
CPWEI Mobile
NATA Nonroad Mobile
NATA Onroad Mobile
CPWEI Area
NATA Area and Other
CPWEI Major
NATA Major
Diesel Particulate
Benzene
Carbon Tetrachloride
Formaldehyde
POM, Total
Chromium Compounds
Selenium
Chloroform
1,3-Butadiene
Ethylene Dichloride